Growing the Model-based Skill Sets in University and Enterprises for the Systems Engineering Discipline

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Special Interest Group Objective

The objective of this SIG is to explore and understand the current state of growing engineers with an MBSE skillset.

We will approach this in two contexts in which MBSE skillset education occurs, the first being formal education in higher-education settings. Challenges with university students begin with their generally not knowing what it means to model a system. Once introduced to the concepts, they have no idea how to implement modeling in a useful way, in a way in which they gain information about the modeled system. We will then look at the ways in which these challenges are met and overcome in our experience.

The second context involves industry. Tech companies are striving to introduce MBSE methods into their working processes, and there are many examples of industry engaging with universities and colleges to provide MBSE education to their employees, e.g. via Masters' degree programs available in the workplace. These programs are often populated by working engineers at various career levels. [*Beshoy* – any words on particular problems or successes with these inyour experience?]. We will also look examples of industry employing less structured ways, such as workshops, conferences, and on-the-job training, to encourage the growth of MBSE skillsets in their workforce.

We will encourage the SIG participants to share their experiences in trying to find MBSE practitioners, or to improve their own skills in the field, and steer the discussion toward identifying ways in which the growing of an MBSE-ready workforce might be improved.

Survey of JPL Practitioners

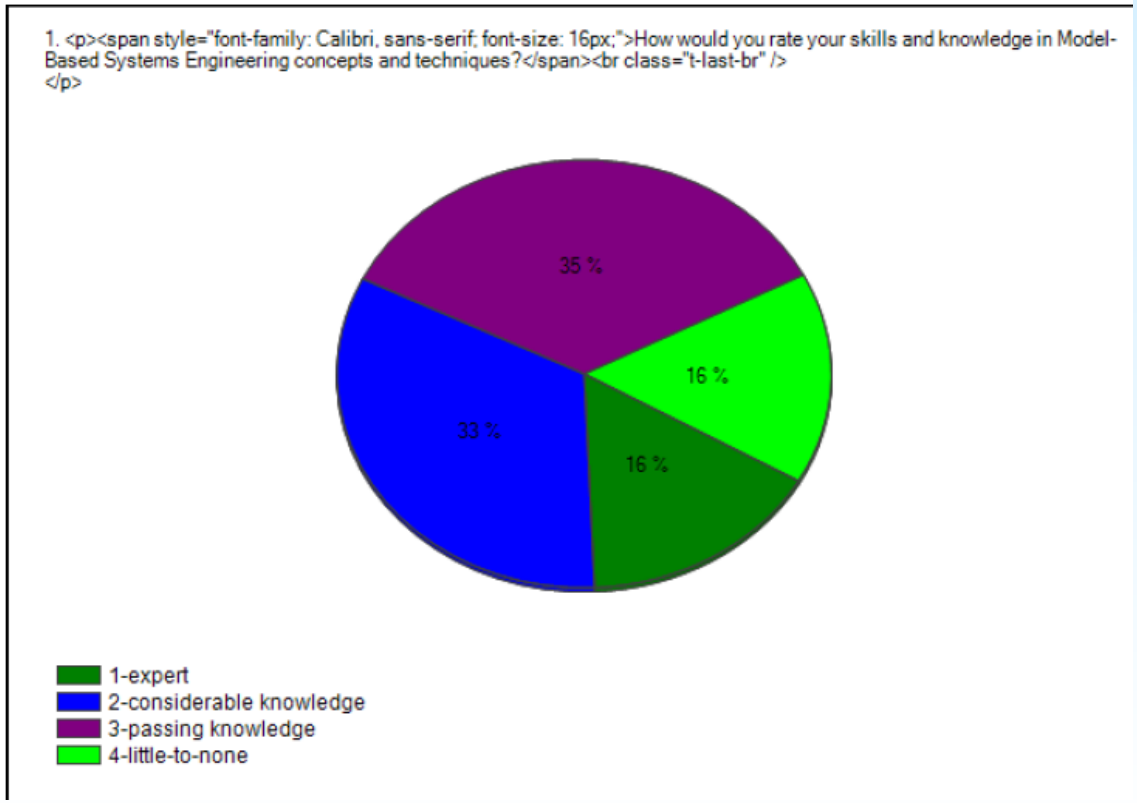
To try to understand how an MBSE skill set is, or is not, being grown in JPL, we asked systems engineering practitioners in JPL to fill out a short survey:

- Rank their own skills
- Tell how they got their skills
- Report on the value of those skills in the institution

63 responses (out of roughly 400 requests)

- Far from a representative sample across the Lab
- MBSE enthusiasts more likely to answer (notable exceptions too)

Question 1 on General Skill Level



84% report at least passing knowledge or better – speaks to who chose to answer

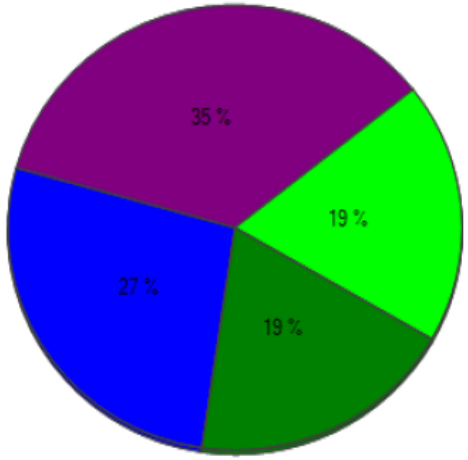
Self-ranking of more specific skills more like 75%.

Question 2 on Skill Specifics

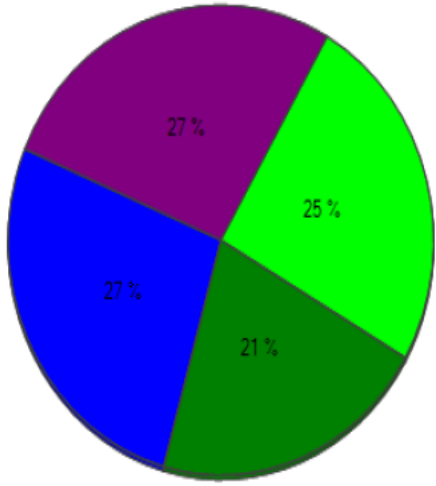
2. Please rate your skills a little more specifically: for each skill area listed, rank your knowledge and ability:

Row: Applying modeling to accomplish communication of architecture and design

Row: Applying modeling to develop and create architecture and design

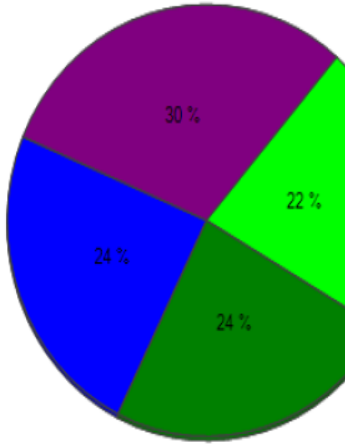


Using modeling to accomplish system analyses

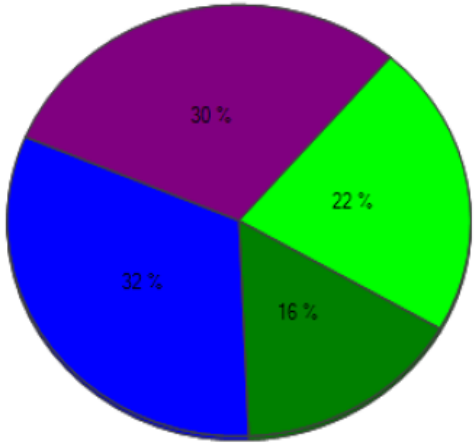


Most confidence in being able to communicate architecture & design

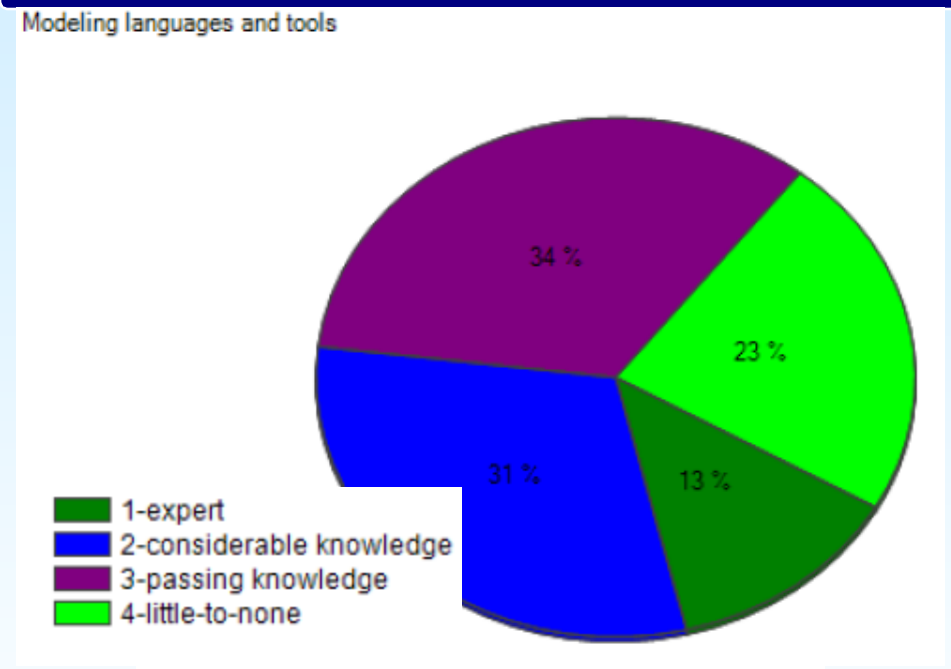
Row: Using modeling to make Systems Engineering products

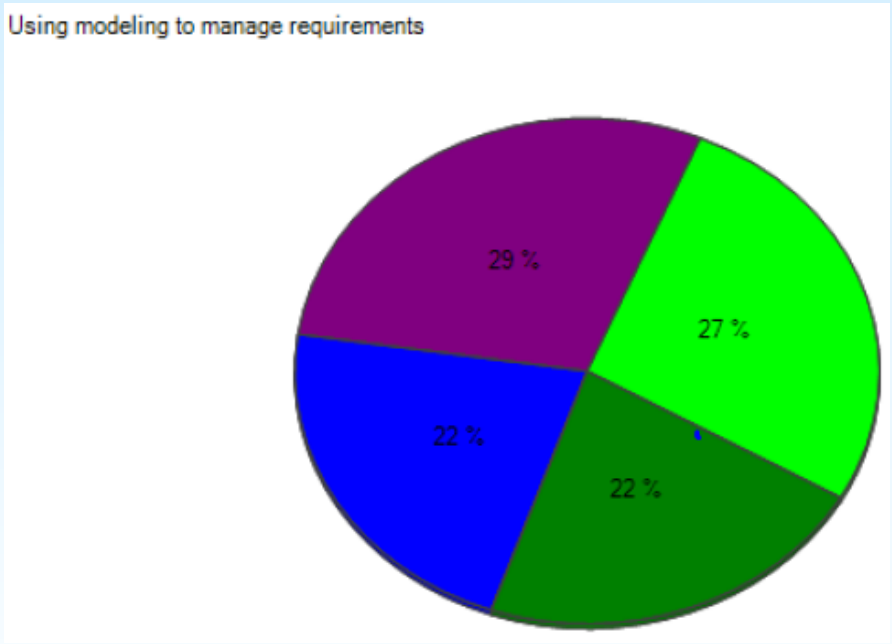


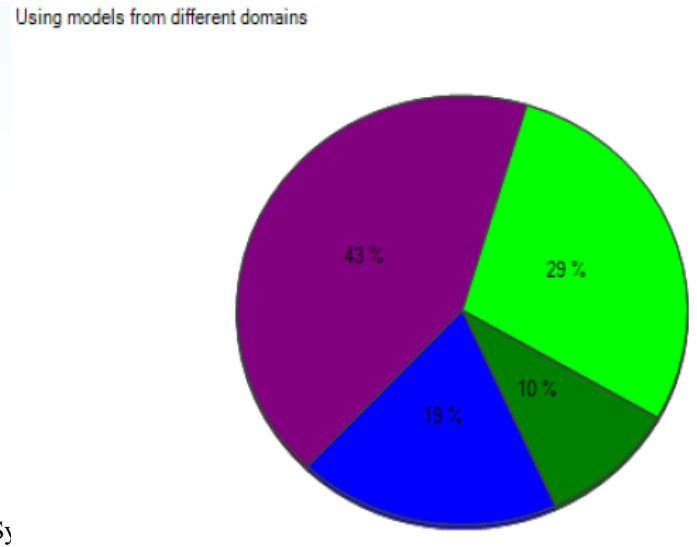
Using modeling to perform trades



Question 2 on Skill Specifics (cont)





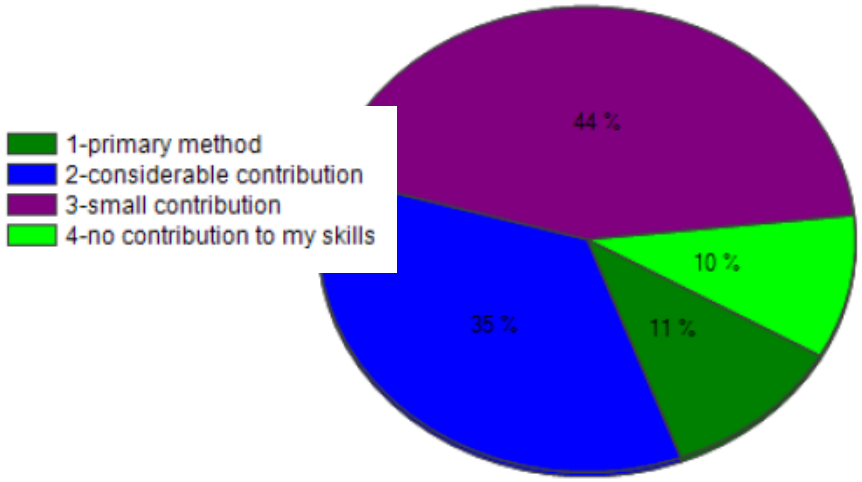


Least confidence in using models from different domains together

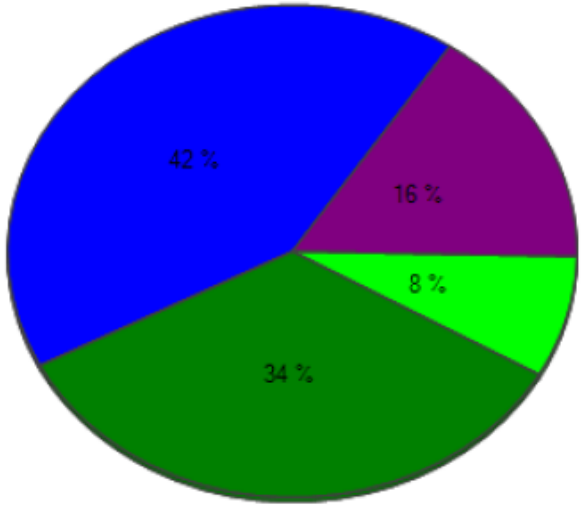
Question 3 on Learning Methods

3. How did you acquire your skills?

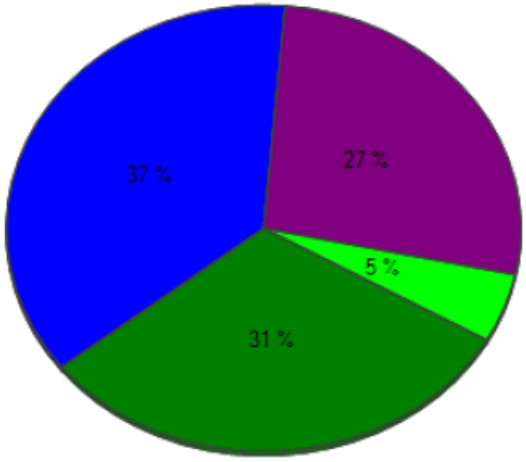
Row: Class instruction (formal or otherwise, internal or external to JPL)



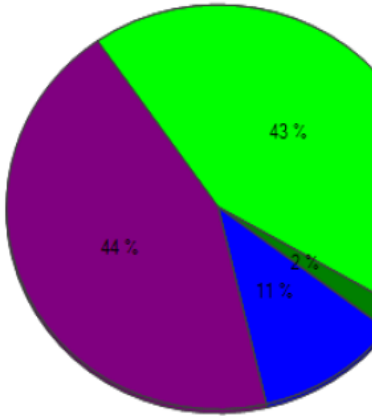
Learning from colleagues in context of a task



Self study



Conferences or other networking

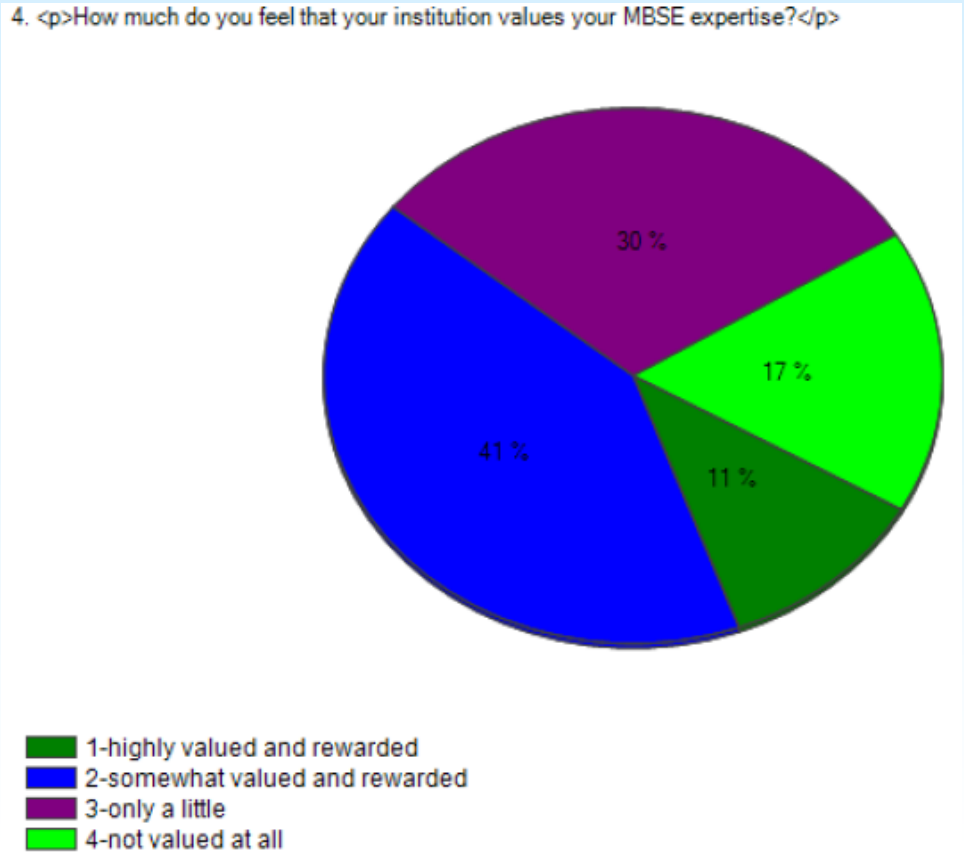


On the job learning: 76%

Self study: 68%

Classes & conferences: not so much…

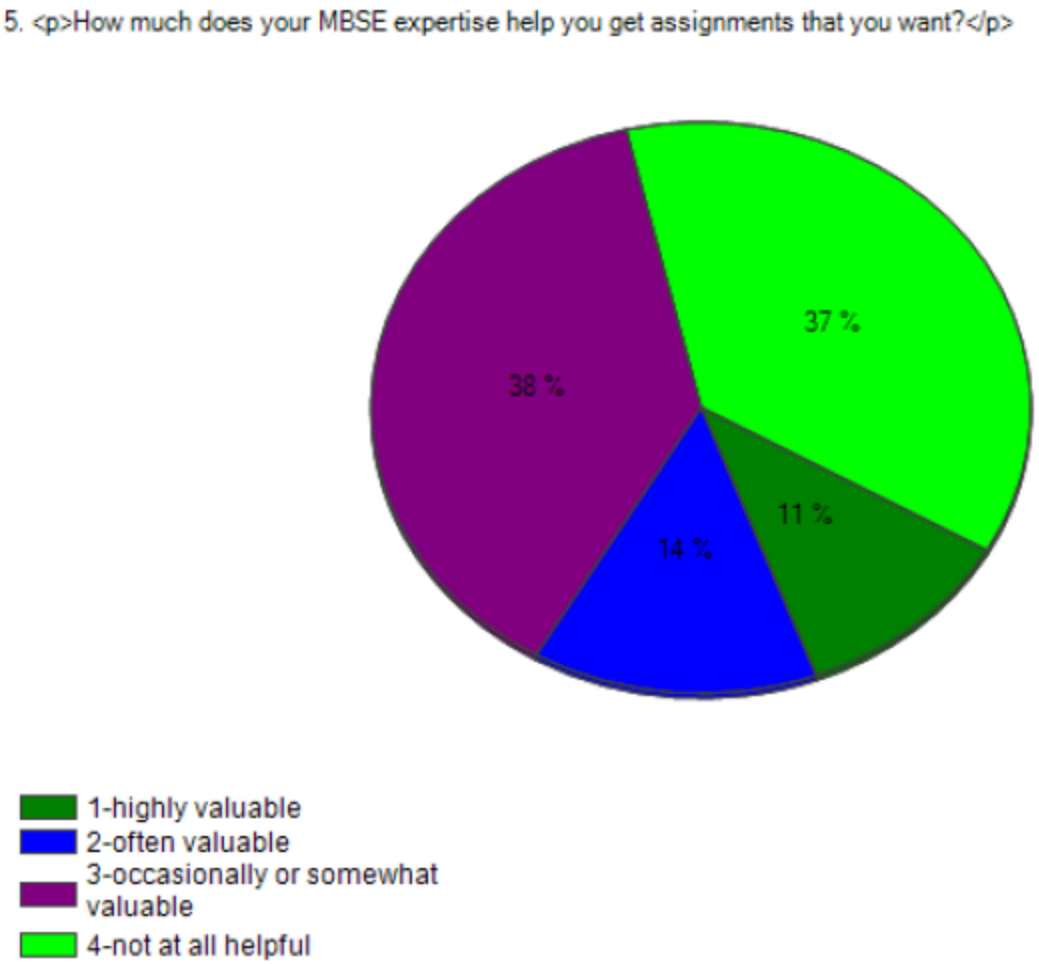
Question 4 on Institutional Valuation



Valued somewhat or more: 52%

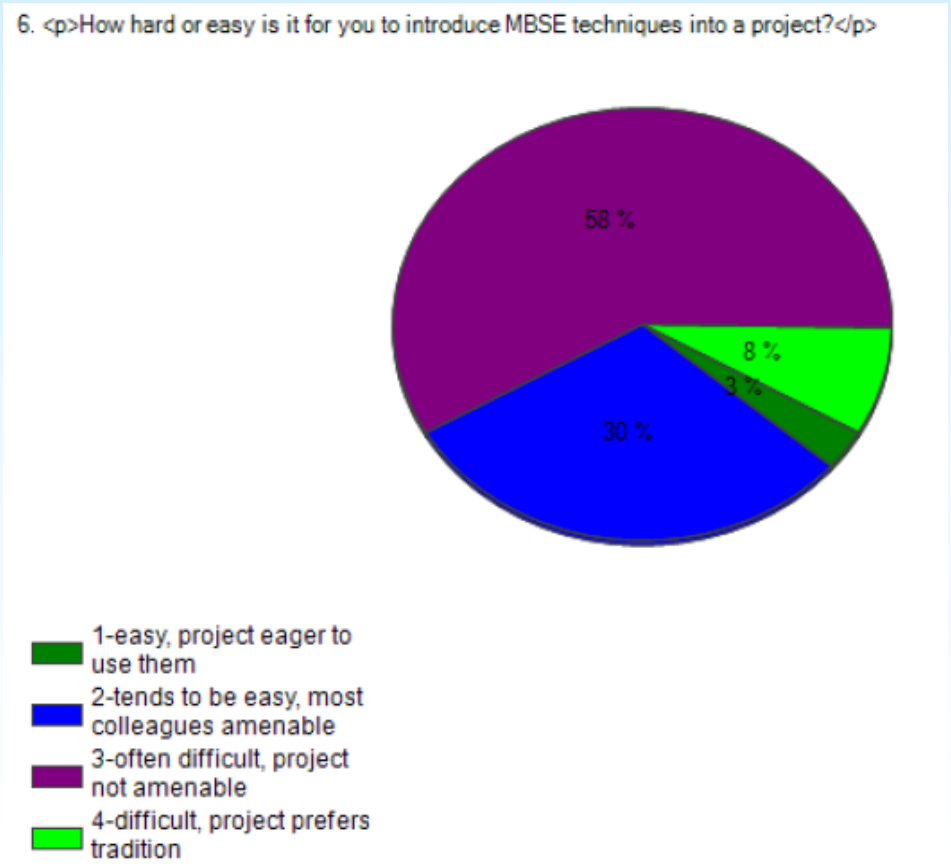
Valued little or not at all: 47%

Question 5



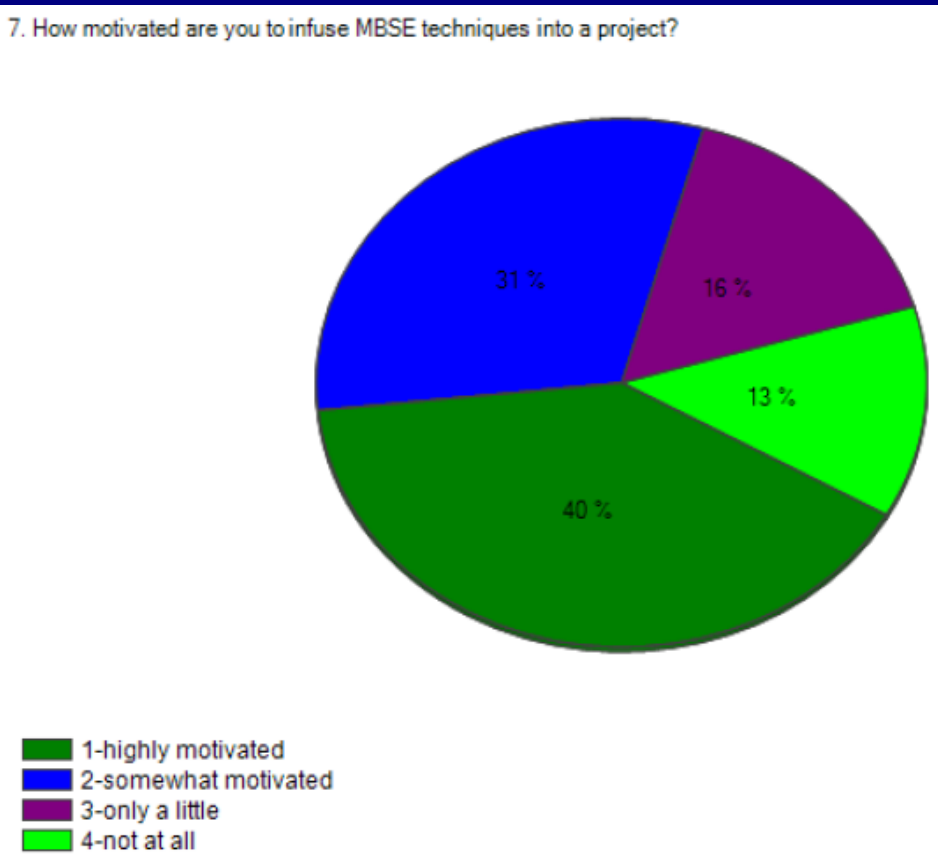
Consistent with previous question

Question 6



66% report lack of interest or resistance to adoption of MBSE methods

Question 7



71% at least somewhat motivated to use MBSE techniques on a project

Question 8

8. What opportunities for additional training in MBSE would you like to see (if any): Please list very briefly your ideas.	
1.	Practical use of SysML, ala Friedenthal. We've had too much emphasis on rolling our own architecture methodologies and have inadequately leveraged the considerable capabilities of existing languages and tools.
2.	A "How to Apply MBSE the JPL Way" type course may be helpful
3.	Formal MBSE methodology for JPL. Standardized software, terminology, processes, etc...
4.	Need balance in MBSE implementation and expectations- only zealots and haters and that's crazy.
5.	1) Trainings/examples on IMCE ontologies/patterns (how to "build an IMCE compatible model") 2) Trainings/examples on various tools to query the model (how to "use an IMCE compatible model") e.g. Cameo/Tom Sawyer/etc.
6.	#6 is N/A to me, not going to answer.
7.	Some more direct involvement/piloting with CubeSat missions
8.	Not a believer in MBSE for flight projects. I don't think the lab should be investing/pushing MBSE as much as it is.
9.	A class that outlines several JPL SE products and walks through how MBSE can help create those products more quickly, thoroughly and correctly compared to non-MBSE approaches.
10.	Training staff in MBSE is a technology push unless projects are amenable to applying MBSE. Recommend focusing on helping realize that MBSE can be very cost effective. Then we'll have a technology pull. MBSE
11.	My experience of MBSE training is that it is very abstract. I'd like to see much more emphasis on jargon-free solutions to real project problems with examples, and providing incremental improvement to existing processes. Few people providing training seem to know how to explain MBSE benefits, preferring instead to teach a new language or tool operation.
12.	We need a course on the JPL methodology to MBSE (as incrementally defined by CAESAR)
13.	on the job training - more infusion
14.	structured training in all aspects of systems engineering, showing examples and benefits of using a system model in the course of system development and operation
15.	N/A
16.	Suggest training project management. Also we need better tools.
17.	real-world use cases in training; comprehensive access to MBSE products from other missions as examples
18.	Formal discipline specific systems engineering training curriculum.
19.	Note that MBSE is not defined, and I used a definition that's closer to MBE. For example, colleagues are not amenable to using Magic Draw, but they are very amenable to using new methods that they understand and believe will save them time.